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Subject: **Oxyfluorfen – Revised Drinking Water Assessment – Apples**

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Summary

This is a revised Drinking Water Assessment and replaces the assessment forwarded to you in July where recommended drinking water concentrations were based on the cotton use scenario. Improvements in the PRZM/EXAMS modeling scenario for Oregon apples now result in higher drinking water estimates than were previously communicated.

In the environment, Oxyfluorfen is expected to be very persistent with low mobility. In general oxyfluorfen degrades very slowly in both soil and water and binds strongly to soil. Modeling results generally predict low concentrations in surface and groundwater but when oxyfluorfen reaches water it is likely to persist for long periods.

The proposed surface water-derived drinking water concentrations are:

23.4 µg /L for the 1 in 10 year annual peak concentration (acute)
7.1 µg /L for the 1 in 10 year annual mean concentration (chronic) and
5.7 µg /L for the 36 year annual mean concentration.

These concentrations were derived from modeling oxyfluorfen use on Oregon apples with an application rate of 2.0 lb ai/acre. The recommended estimates changed from the previous Drinking Water Assessment (DP Barcode - D275798) due to improvements in the PRZM/EXAMS scenario for Oregon apples.

The SCI-GROW model concentration estimate of oxyfluorfen in drinking water from shallow groundwater sources is **0.08** µg/L. This concentration can be considered as both the acute and chronic value.

<u>1) Surface Water Modeling</u>

Modeling results are the source of the proposed drinking water concentrations. Three different crop scenarios; citrus in Florida, apples in Oregon, and cotton in Mississippi were chosen to estimate the concentration of oxyfluorfen in surface drinking water. These scenarios were chosen to represent a geographically dispersed range of modeled surface water concentrations in areas representative of where oxyfluorfen is heavily used (west coast states and the Mississippi delta region) or has the potential for heavy use (Florida).

PRZM 3.12/ EXAMS 2.7.97 modeling was performed with index reservoir (IR) scenarios and percent cropped area (PCA) adjustment factors. For a description of the IR/PCA scenarios and the uncertainties associated with them see R.D. Jones et al (March 21, 2000). A default PCA factor of 0.87 was used for citrus and apples because a PCA factor for these crops is not available. PCA factors of 0.20 and 0.87 were applied to cotton model results. The more conservative 0.87 factor was applied to cotton results to account for the possibility of other crops grown within cotton watersheds being treated with oxyfluorfen. A review of use/usage data (Quantitative Usage Analysis from BEAD) suggests that oxyfluorfen use on cotton occurs in areas where uses on other crops (peaches, cabbage, onion, soybeans, citrus, and broccoli) does occur or could potentially occur. EFED recommends that the estimated concentrations of oxyfluorfen derived from the apple scenario with the 0.87 PCA factor be used in the human health risk assessment.

Tables 1 and 2 present the PRZM/EXAMS estimated concentrations of oxyfluorfen in surface drinking water for the three different crop scenarios and the model input parameters:

TABLE 1. TIER 2 CONCENTRATION OF OXYFLUORFEN IN SURFACE WATER USING IR/PCA PRZM/EXAMS SCENARIOS						
Crop Scenario	**Application Rate** (lbs ai/acre)	**Number of Applications**	**PCA Adjustment Factor**	**1/10 Peak Conc.**	**1/10 Yearly Conc.**	**36 Year Annual Mean Conc.**
Citrus (non-bearing)	2.0 lbs ai/acre	2	0.87 (default)	51.6 μg /L	10.4 μg /L	7.4 μg /L
Apples*	2.0 lbs ai/acre	1	0.87 (default)	**23.4 μg /L***	**7.1 μg /L***	**5.7 μg /L***
Cotton	0.5 lbs ai/acre	1	0.87 (default)	13.6 μg /L	5.1 μg /L	3.2 μg /L
Cotton	0.5 lbs ai/acre	1	0.20 (cotton)	3.1 μg /L	1.2 μg /L	0.7 μg /L

***** Recommended for use in the human health risk assessment.

Table 2. PRZM/EXAMS INPUT PARAMETERS FOR OXYFLUORFEN			
MODEL PARAMETER	**VALUE**	**COMMENTS**	**SOURCE**
Application Rate	0.5 lbs ai/acre for cotton 2.0 lbs ai/acre for apples and citrus		Label (Goal 2XL EPA Reg. No. 700-243)
Number of Applications	1 application for cotton and apples 2 applications for citrus		Label (Goal 2XL EPA Reg. No. 700-243)
Aerobic Soil Metabolism $t_{1/2}$	870.5 days	estimated 90 th upper percentile	MRID #s 92136110, 92136097
Anaerobic Soil Metabolism $t_{1/2}$	653.9 days	estimated 90 th upper percentile	MRID # 92136111
Aerobic Aquatic Degradation Rate (KBACW)	1.66 x10-5 $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{1/2}$ 1741 days)	half the aerobic soil metabolism degradation rate	MRID #s 92136110, 92136097
Anaerobic Aquatic Degradation Rate (KBACS)	$2.21x10^{-5}$ $(cfu/mL)^{-1}$ $hour^{-1}$ ($t_{1/2}$ 1308 days)	half the anaerobic soil metabolism degradation rate	MRID # 92136111
Aqueous Photolysis $t_{1/2}$	7.5 days		MRID # 42129101
Hydrolysis $t_{1/2}$	Stable		MRID #00096882
K_{OC}	5585 ml/g	Lowest non sand	MRID #s 92136112, 92136099
Molecular Weight	361.7		Product Chemistry
Water Solubility	1.16 mg/l	10 x solubility	Product Chemistry
Vapor Pressure	2.0 E-5 torr		Product Chemistry

Although the modeling results for citrus produce higher results, EFED recommends the apple scenario be used for the drinking water concentration of oxyfluorfen in surface water. The apple IR scenario (adjusted for a default PCA factor of 0.87) produced a 1 in 10 year annual peak concentration (acute) of **23.4** µg /L. The 1 in 10 year annual mean concentration (chronic) was **7.1** µg /L. The 36 year annual mean concentration was **5.7** µg /L. EFED believes the limitation of oxyfluorfen use to non-bearing citrus precludes large portions of watersheds from being treated simultaneously, as is simulated in the model. The term “non-bearing” refers to young trees which are not producing substantial quantities of fruit and is distinct from dormant trees which are not in a fruiting season. It is unlikely that a substantial portion of a watershed would be comprised of non-bearing citrus. Therefore the apple scenario provides a more realistic drinking water concentration.

The citrus, apple and cotton scenarios do not represent the highest registered use rates for oxyfluorfen. Rates for ornamentals, coffee, and cacao are higher than the modeled application rates. Although the highest application rates were not modeled, the proposed drinking water concentration is expected to be conservative because of geographic and usage area considerations discussed below.

The label use rate of granular oxyfluorfen on ornamentals at 8 lbs ai/acre, represents the highest registered use rate. Not having an IR/PCA PRZM/EXAMS scenario for ornamentals, prevented EFED from modeling the highest registered use rate. However, it is not expected that large portions of drinking water watersheds are likely to be comprised of ornamental nurseries receiving oxyfluorfen applications.

Label use rates for coffee (grown in Hawaii and Puerto Rico) at 6 lbs ai/acre exceed the rate allowed for citrus, apples, and cotton. However, other than the Kona region of Hawaii, EFED is not aware of coffee growing areas in the US or its territories that contain watersheds compromised largely of land devoted to coffee agriculture. EFED is not aware of any surface water intakes used for drinking water in the Kona region of Hawaii. The absence of surface water intakes in Kona and the absence of watersheds comprised largely of coffee agriculture suggest that oxyfluorfen use on coffee at present is unlikely to contaminate drinking water at levels greater than the recommended drinking water concentration above.

Label use rates for Cacao at 6 lbs ai/acre, also exceed the rate allowed for citrus, apples, and cotton. However, EFED is not aware of watersheds containing cacao agriculture in the US or its territories.

A recent drinking water assessment (supporting a section 18 request, DP Barcode D252219) estimated lower concentrations for oxyfluorfen in water. The change in concentration is attributed to more realistic scenario parameters for Oregon apples, as well as the use of different model input parameters for the aerobic soil metabolism half-life, anaerobic metabolism half-life, and aqueous photolysis half-life. The water solubility input was also changed but this difference was not expected to affect the results. The input parameters used in this assessment are consistent with EFED's current input selection policies for using an upper percentile input for the aerobic soil metabolism and estimating anaerobic aquatic degradation rate when no data are submitted.

2) Surface Water Monitoring

There are limited surface water monitoring data available for oxyfluorfen. The data are not adequate to perform a quantitative drinking water assessment because: 1) dissolved oxyfluorfen concentrations are most relevant to drinking water concentrations but some data is limited to sediment levels; 2) oxyfluorfen use is widespread but the monitoring data is limited to a few locations; 3) oxyfluorfen application timing is broad and guideline fate data suggest it is likely to be persistent but the monitoring data is temporally limited.

Oxyfluorfen was not analyzed as a standard analyte under the National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey (USGS). The USGS did, however, measure oxyfluorfen concentrations in suspended sediment in the San Joaquin River in central California. In addition to the USGS data, some samples have been collected and analyzed for oxyfluorfen in water and sediments in the Columbia River basin of Oregon and Washington. Brief summaries of the results collected are presented below in order to characterize oxyflourfen occurrence in surface waters used to supply drinking water.

USGS: The USGS has conducted monitoring of oxyfluorfen bound to suspended sediment in central California (Bergamaschi et al 1997, Bergamaschi et al 1999). The monitoring data is relevant to drinking water because it was collected in the vicinity of drinking water intakes (such as the intake for Antioch CA), it is collected from the same water bodies used for surface drinking water sources, and is collected downstream of areas where oxyfluorfen is heavily used. The data show frequent detections of oxyfluorfen associated with sediment during several years in the 1990's. Average concentrations of oxyfluorfen associated with suspended sediment at four sites ranged from **1.0** to **27.2 ppb** (Bergamaschi et al 1997). Since sediment is removed from water during the water treatment process, dissolved phase concentrations are more useful for estimating drinking water exposure. If oxyfluorfen partitioning between water and sediment is assumed to be reversible and at equilibrium upon entering the drinking water facility intake, the K_d partitioning coefficient may be used with sediment bound concentrations to estimate how much oxyfluorfen is present in the dissolved phase (see Figure 1).

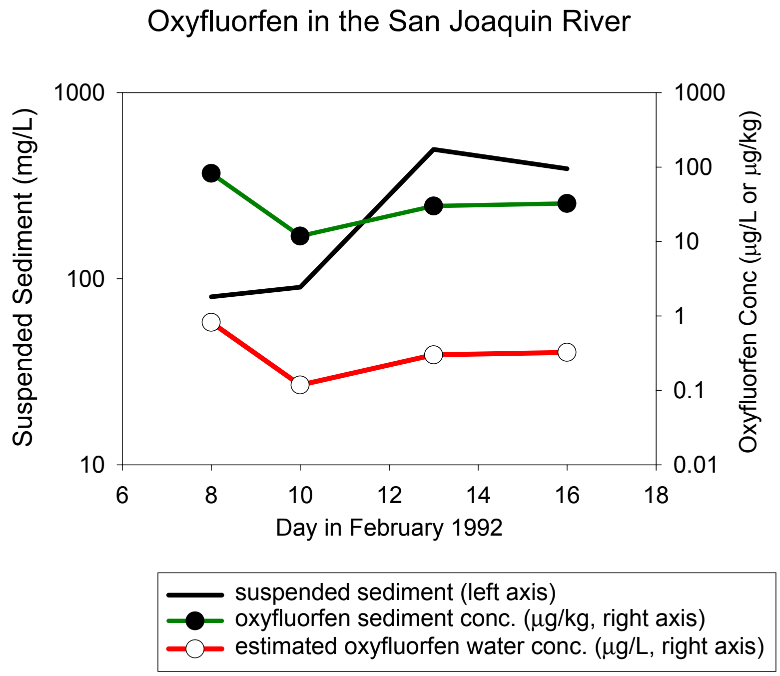

Figure 1. USGS data for sediment levels and sediment associated oxyfluorfen concentrations was graphed and adjusted by the average of three non-sand soil/water partition coefficients, K_d s, from guideline studies to estimate dissolved phase oxyfluorfen concentrations. The average K_d was 100. Inherent in this calculation is the assumption that oxyfluorfen binding is reversible and at equilibrium. Analysis of other pesticides associated with sediment in the same area suggests that dissolved phase concentrations are lower than would be expected based on partition coefficients.

Transit time from fields where sediments were removed and where river sediments were sampled is short. A number of other pesticides measured on sediments were present only at low or undetectable levels, presumably because sediments did not have adequate time to reach equilibrium with water. If dissociation kinetics of sediment bound oxyfluorfen are also slow, the concentrations estimated in Figure 1 are likely higher than those that were actually present.

Columbia River Basin: Fifteen Mile Creek near the Dalles Dam in Oregon was the site of an oxyfluorfen spill (August 24, 2000). A truck carrying formulated oxyfluorfen (Goal 2XL) crashed on a bridge dumping thousands of gallons of herbicide into the creek yards from where the creek enters the Columbia River. Oxyfluorfen measurements were made in water, soil, and sediment in response to the spill. In order to determine background levels of oxyfluorfen in the environment, the spill response team collected several samples in areas that were unaffected by the spill, including upstream in Fifteen Mile Creek, upstream in the Columbia River, and in other creeks feeding into the Columbia River. The samples collected are relevant to drinking water because the Columbia River is used as a drinking water source and significant oxyfluorfen use is understood to occur in the watershed. Most samples collected up and downstream outside the spill site contained undetectable levels (< 0.01 ppb) of oxyfluorfen. Excluding the two weeks immediately following the spill, only 7 of approximately 300 water samples collected in the Columbia contained any detectable levels of oxyfluorfen. The detections were at relatively high levels and were most likely a result of leakage from the spill site. The few water samples collected from nearby rivers contained undetectable levels. Of 35 background sediment measurements made in nearby rivers and streams which were unaffected by the spill, 2 detections of oxyfluorfen in sediment were noted. The highest detection, 541 ppb in Mosier Creek, is downstream of orchards (see Figure 2).

Figure 2. An aerial photograph of orchards on Mosier Creek Oregon near where oxyfluorfen was detected in sediments.

For a further discussion of oxyfluorfen persistence in sediments, see the Environmental Fate section EFED's RED chapter.

3) Ground Water

Oxyfluorfen's capacity to bind strongly to soil reduces its potential to contaminate ground water. There are limited ground water monitoring data readily available for oxyfluorfen. Oxyfluorfen was included in the 1992 *Pesticides in Ground Water Database* (U.S. EPA/EFED/EFGWB). Among 188 wells sampled in the state of Texas between 1987 and 1988, no detections of oxyfluorfen were reported. Because of the limited availability of ground water monitoring data, the SCI-GROW screening model was used to estimate ground water concentrations. The model estimates upper-bound ground water concentrations of pesticides likely to occur when the pesticide is used at the maximum allowable rate in areas where ground water is vulnerable to contamination. Since SCI-GROW, unlike the PRZM/EXAMS surface water models, does not require a specific crop scenario, EFED used the highest use rate of four applications at 2.0 lbs ai/acre as used for ornamentals to estimate the concentration of oxyfluorfen in drinking water from shallow groundwater sources. Table 3 presents the input parameters used in the SCI-GROW model.

Table 3. SCI-GROW Input Parameters			
Model Input Parameters	**Input Value**	**Comments**	**Source**
Aerobic Soil Metabolism $t_{1/2}$	434 days	Average value	MRID #s 92136110, 92136097
K_{OC}	6831	Median value	MRID #s 92136112, 92136099
Application Rate	2.0 lbs ai/acre		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)
Max. Number of Application Per Season	4 applications		Label (Rout Ornamental Herbicide, EPA Reg. No. 58185-27)

The SCI-GROW model estimated the concentration of oxyfluorfen in drinking water from shallow ground water sources to be **0.08** µg/L. This concentration can be considered as both the acute and chronic value.

4) References

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